

## CONTACT LENS REJUVENATING SOLUTION

## BACKGROUND OF THE INVENTION

## 1. Field of the Invention

This invention relates generally to solutions for removing occluded and adsorbed chemicals, such as cationic preserving agents, anionic preserving agents or mixtures thereof, from contact lenses which comprises a nonionic surfactant; a cationic ion exchange resin, an anionic ion exchange resin, or mixtures thereof; water; and optionally sodium chloride. Such solutions are useful to reduce and prevent chemical irritation of the eye of the contact lens wearer.

## 2. Related Disclosures

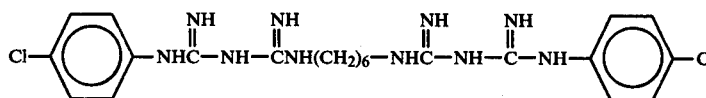
The widespread development of the contact lens technology and contact lens use did not occur until the expansion of polymer and plastic chemistry in the 1930's and 1940's. It is useful to classify contact lenses as being hard, rigid, gas-permeable, flexible, or soft hydrogel, depending upon the structural characteristics of the material used to fabricate the lens. The majority of the lenses in use today are made of, or include some, poly(methylmethacrylate). Polymers and copolymers of polymethylmethacrylate, cellulose acetate butyrate, siloxanes, fluoroalkyl-methylmethacrylate, N-vinyl-2-pyrrolidone and the like may be classified as hard or flexible, depending upon the ratio of the components. Silicone rubber and silicone-polycarbonate polymers are usually classified as flexible polymers. Soft contact lenses are usually made from cross-linked hydrophilic polymers and copolymers such as 2-hydroxyethylmethacrylate 2,3-dihydroxypropylmethacrylate, methylmethacrylate, methacrylic acid, N-vinyl-2-pyrrolidone, and the like which can be hydrated with about 20-85 percent water. A recent review by M. Refojo on current contact lens technology can be found in the *Encyclopedia of Chemical Technology*, Kirk-Othmer, Ed., Vol. 6, 3rd ed., published in 1979 by John Wiley and Sons, pp. 720-742.

Soft contact lenses of the hydrated gel type have a number of properties which pose problems for the wearer. One of these problems is the method of cleaning and sterilizing the lenses. One sterilization method (the hot method) is to boil the lenses in water or saline solution. Other methods of cleaning and sterilization (chemical methods) include treating the lenses with a 3% solution of hydrogen peroxide followed by rinsing with a solution containing a neutralizing agent and preserving composition. Compounds which have been useful in contact lens solutions as bactericides and germicides or preserving agents include chlorhexidine digluconate, alkyltriethanol ammonium chloride, iodophors, thimerosal (a mercury compound), chlorobutanol, benzalkonium chloride, sodium tetracemidine sorbic acid, phenylmercuric chloride and cetyl pyridinium chloride. It is known that many of these preservatives concentrate with time in the hydrogel soft contact lenses. When these concentrated preservatives are subsequently released to the cornea during wearing, they may cause serious chemical burns. Other wearers have

experienced allergic responses to these chemicals, even at low concentrations.

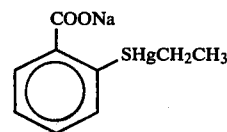
Nearly all of the contact lens solutions presently being marketed use chlorhexidine, thimerosal, or benzalkonium chloride as preservative agents. Some solutions such as SOFTMATE, marketed by Barnes-Hind, Inc.; FLEXCARE and DISINFECTING SOL'N marketed by Bausch and Lomb; and FLEXSOL marketed by Burton Parsons Co. Inc., use a mixture of chlorhexidine and thimerosal as the preserving agent.

Chlorhexidine, a type of biguanide compound which is a popular component of current contact lens solutions, has the chemical name, 1,1'-hexamethylene-bis-[5-(p-chlorophenyl)]biguanide and the following chemical structure:



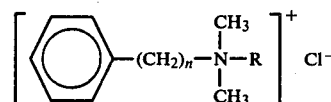
Chlorhexidine is sold under trademarks such as HIBITANE, NOLVAEAN, ROTUSEPT and STERILON. Their use in contact lens solutions is detailed in U.S. Pat. Nos. 3,882,036 and 3,888,782, which are incorporated herein by reference. Several derivatives such as the diacetate and digluconate (also known as HIBISCRUB) are also available.

Thimerosal, a type of anionic organic mercury compound, is a current preservative of contact lens solutions with the chemical name, sodium ethylmercurithiosalicylate, and has the following structure:



Thimerosal is also sold under trademarks such as MERTHIOLATE SODIUM, MERZONIN, MERTORGAN, and MERFAMIN. Its use in contact lens solutions is discussed in U.S. Pat. Nos. 3,888,782 and 4,029,817, which are incorporated herein by reference.

Benzalkonium chloride, a mixture of alkyl dimethylbenzylammonium chlorides, is also currently used as a preservative, and has the following generalized structure:



where R represents a mixture of alkyls from C<sub>8</sub>H<sub>17</sub> to C<sub>18</sub>H<sub>37</sub>, and n is an integer from 1-5.

Benzalkonium chloride is also sold under trademarks such as ZEPHIRAN CHLORIDE, ZEPHIROL, BTC, ROCCAL, BENIROL, ENUCLEN, GERMITEL, DRAPOLENE, DRAPOLEX, CEQUARTYL, PARALKAV, GERMINOL, RODALON and OSVAN. Its use in contact lens solution is discussed in U.S. Pat. No. 3,882,036 which is incorporated herein by reference.

It is an object of this invention to provide chemical solutions to rejuvenate a hard, rigid, gas-permeable or